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THE ROLE OF LEAN-MANAGEMENT IN REDUCING THE RISK OF MORBIDITY OF MALE EMPLOYEES IN THE SHIPBUILDING INDUSTRY

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The purpose of the work. The development of an analytical model for assessing the impact of Lean-management principles on reducing the risk of diseases in male shipbuilders and ship-repair workers. The paper presents the results of assessing the impact of the Lean-management principles in the organization of medical care for male employees of shipbuilding and ship repair enterprises on reducing the risk of professionally caused diseases. The data for the analysis were collected from the medical history of the hospital patient and the medical records of the patient who received ambulatory medical care in the Federal State Healthcare Establishment of the South-district Medical Center of the Federal Medical-biological Agency of the Russian Federation in the period of 2015–2017 and in 2019. Methods of expert assessments and mathematical modeling are used. The estimated risks of diseases including industrial hazards of the male workers of the shipbuilding and ship-repair enterprises of the town of Astrakhan, the ability to cut the use of Lean-management in the organization of medical help to employees of the male shipyard. The analytical model for assessing the impact of the Lean-management principles on reducing the risks of work-related diseases and providing the effectiveness of organizing medical care for male workers in shipbuilding and ship-repair is developed. It is stated that the risk of developing work-related diseases have been reduced by 25–30 %. The introduction of the Lean- management principles in the work of polyclinics has significantly helped to reduce the chance of the work-related diseases of male workers in the shipbuilding industry. The implementation of the Lean–management principles in the work of the polyclinics allowed not only to optimize the work of this medical establishment, to increase staff satisfaction, but also to cut the impact on professional risk factors on the health of male shipbuilders.

Key words: *prevention, risk, morbidity, Lean-management, male employees of the shipbuilding industry.*

Introduction. Globally, healthcare systems are at a cross roads. Many political and healthcare leaders, and in fact the society itself is demanding the redesign of healthcare delivery [6]. The concern is fuelled by ever increasing costs and high expectations of patients. In the current economic situation, with an irrational distribution of costs with a funding gap associated with the provision of high-quality medical services, as well as in the conditions of fierce competition, the management of medical organizations raises quite sharply the question of the efficient allocation and use of available resources. Resources should be allocated not only efficiently, but also should take into account the degree of satisfaction of citizens on the level of quality of medical services provided.

In the context of a change in the managerial vision in the public sphere, strengthening of political, economic, social and technological risks for stakeholders of medical organizations, it became necessary to create a new effective system for managing medical organizations. Such as, Lean-management. In our study, we touched on the problem of introducing the principles of Lean-management in ship and industrial medicine.

The main aim of the state program «The development of shipbuilding for 2013-2030» is to make a fundamental improvement in the strategic competitive position of Russian shipbuilding industry in the world and to make sure that the needs of the state and domestic business in modern shipbuilding products can be fully met [3]. To achieve this goal, it is necessary to point out one of the most important tasks: maintaining a sufficient level of health of the staff potential of the shipbuilding industry [8]. The specific feature of the industry is that most of the employees are male [5]. The men of working age are the state's genetic resource. Russia ranks first in Europe among the countries with the highest mortality rate for men under the age of 65, as shown by The World Bank data, which estimates that 43% of men in Russia die before the age of 65.

Men's life expectancy is affected by the state of the economy, and as a result, the financial situation of people, lifestyle, stress, and the level of organization of medical care [1, 2, 4, 7, 9, 10, 11, 12].

It is statistically proven that a healthy, physically strong person is less prone to accidental and occupational injuries due to a good reaction. He has a higher resistance to diseases, penetrating radiation and the influence of harmful working conditions. That is why investing in the health of male employees of shipbuilding and ship repair companies is a priority. In this aspect, the health care industry is the most effective area of investment.

The use of the Lean-management methods in the framework of pilot projects implemented in the Russian Federation over the past four years shows significant advantages in the work of medical organizations in comparison with traditional approaches to the organization of medical care. Taking in consideration that Russian healthcare solves the issues related to the health of the nation in conditions of severely limited financial resources, there is a need to develop and carry out some innovative approaches.

Therefore, the search for effective methods of managing the health of male shipbuilders, the active implementation of the principles of effective management in the practice of the primary level of the health system and reducing the impact of industrial hazards on the health of shipbuilders were the basis for this study.

The aim of the work. The Development of an analytical model for assessing the impact of the Lean-management principles on reducing the risk of diseases in male shipbuilders and ship repair workers.

Materials and methods. The data collection for the analysis was made from medical records of an inpatient patient (medical history) for 2,450 pieces, medical records of the patients who received medical care in ambulatory conditions in the amount of 1,290 pieces of the Federal State Healthcare Establishment of the South-district Medical Center of the Federal Medical-biological Agency of the Russian Federation within 2015–2017 and in 2019.

The research uses the methods of expert assessments and mathematical modeling and software products: database, Excel spreadsheets, statistical package Statgraphic, Python programming language.

Results and their discussion: according to the data of preventive medical examinations of shipbuilders and ship repairers of the town of Astrakhan, a statistically significant ($p < 0,05$) increase in morbidity was noted from 3680 % in 2015 to 6254.5 % in 2017. The season period indices reflected the seasonality of the work performed, increasing in spring from 38 % in 2015 to 50 % in 2017, and in summer from 32 % in 2015 to 42 % in 2017. Seasonality indices indicated that male workers preferred to seek medical care in the spring and summer – at the height of active work on ship repair and construction.

For a detailed assessment of the impact of risk factors on the health of the male workers of the shipbuilding and ship-repair enterprises the analysis of risk factors and future predictive analysis were performed, a predictive model of mathematical assessment of the impact of medical, social and industrial determinants on the health of the male workers of the shipbuilding and ship-repair enterprises using machine learning methods to build a matrix of scatterplots, and models predictive Analysis was generated. As a result of mathematical modelling, the risks of diseases caused by the impact of negative production factors are calculated.

The most significant were the work with electrical installations with a risk of diseases 0,35, noise with a risk of diseases 0,38, cold microclimate – 0,45, vibration – 0,46 (Fig. 1).

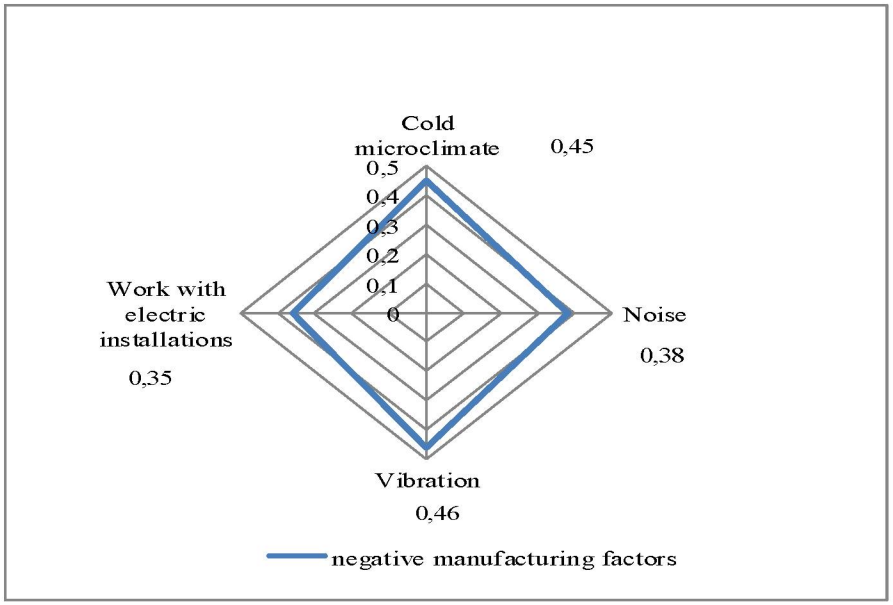

Figure 1. Risks of the diseases in male employees of shipbuilding and ship-repair enterprises as a result of negative production factors

The analytical model included the factor «Therapeutic and preventive measures», which resulted in the reduction of the risk of diseases of shipbuilders to 0,17 for noise, 0,21 for vibration, 0,23 for working with electrical installations, 0,2 for a cold microclimate (Fig. 2).

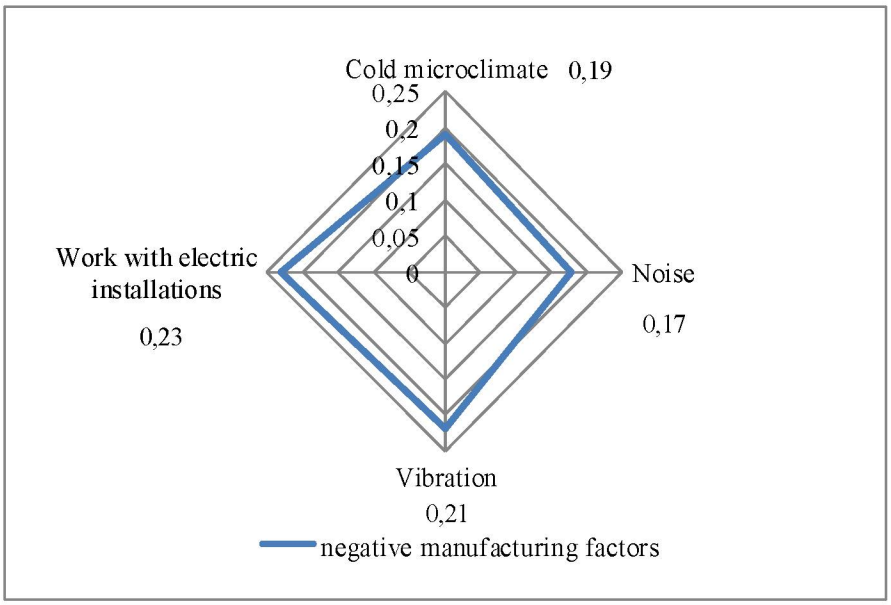

Figure 2. Risks of the **diseases in male employees of shipbuilding and ship repair enterprises due to the inclusion of the «Treatment and prevention measures factor in the model»**

A similar picture of a decrease in the connection between negative manufacturing factors and employee requests for medical care (a decrease in baseline indicators by 30 %) was found when the factor «implementation of Lean-management principles in the organization of medical care» was added to the analytical model (Fig. 3).

At the same time, the risks of the diseases caused by the impact of negative production factors against the background of the introduction of the Lean-management principles in the organization of medical care decreased, making up the production factor «work with electrical installations» – 0,31, «noise» – 0,18, «cold microclimate» – 0,2, «vibration» – 0,25.

The introduction of the Lean-management principles in the organization of medical care has much reduced the correlation between occupational hazards and employee health. There was not only a persistent 25-30 % reduction in the risk of developing work-related diseases, but also an increase in patient satisfaction with the quality of medical care provided. As a result, 30 points increased the clinic's patient loyalty index, and the number of unsatisfied visitors decreased from 50 % to 5 %.Overall, satisfaction increased by 61 %.

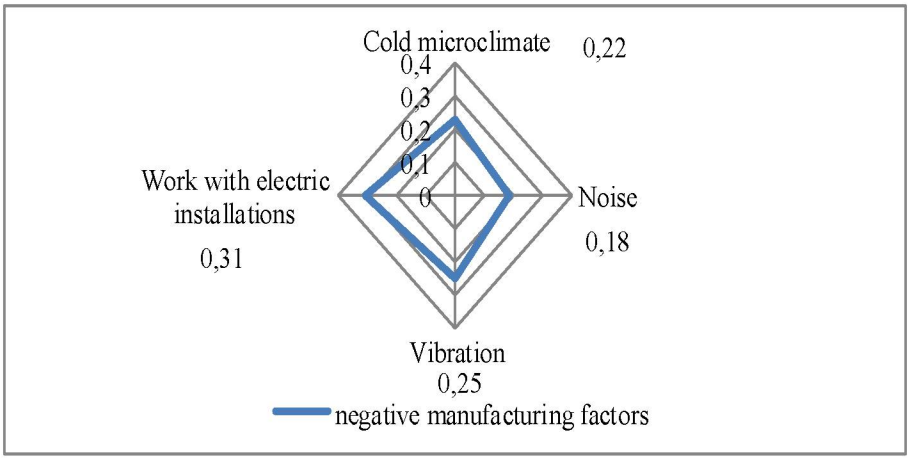

Figure 3. Risks of diseases in male employees of shipbuilding and ship repair enterprises as a result of the inclusion of the factor **«implementation of Lean-management principles in the organization of medical care»**

The developed analytical models for assessing the impact of the principles of Lean-management (reduction of waiting time shipbuilders), preventive measures, reflected the reduction of the negative relationship of production factors and the incidence of shipbuilders, and hence the increase in medical efficiency in a timely manner organized measures: advice on good diets, adherence to labor and recreation, employee training and medical knowledge, the implementation of the principle of protection by time, creation of safe working conditions, conducting individual therapy. The developed analytical model for evaluating the impact of Lean-management principles on the effectiveness of medical care for male shipbuilders and ship repair workers reflected an increase in its medical efficiency with the ability to reduce waiting times and increase the number of patients who passed, increase the likelihood of receiving medical care in a timely manner, and reduce the likelihood of getting sick again.

Conclusions. The objective need to organize medical care for workers in the shipbuilding and ship repair industries through the implementation the of the Lean- management principles in the polyclinic to improve the quality of medical care and prevention was caused by the increase in the incidence of male shipbuilders and the high level of importance of the shipbuilding industry.

The analytical model for assessing the impact of the Lean-management principles on the effectiveness of medical care for male shipbuilders and ship repair workers has shown a decrease in the strength of the correlation between occupational hazards and employee health, and a 25-30 % reduction in the risk of developing professionally-related diseases.

The implementation of the Lean-management principles in the organization of medical care has helped to increase staff satisfaction, reduce the incidence of diseases and the number of days of temporary disability, reduce financial costs, as well as preserve human resources at shipbuilding and ship repair enterprises in the Astrakhan region.

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